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The following statement is a full description of this invention, including the best method of performing it known to us:

19960/73—L X612-77-3D-14P.C. F. D. Atkinson, Government Printer, Canberra

RUPTURE-PROOF SEAMLESS SEALING MEMBRANE IN MULTILAYERED CONCRETE STRUCTURES

The invention relates to water proofing foundations, roof decks, swimming pools and the like and to sealing openings, e.g., cracks and expansion joints, in masonry. Particularly, it relates to sealing openings in concrete foundations or slabs poured on earth underburden, by means of sealing and waterproofing membranes which form barriers to fluid, and which then are covered with an overlayer of concrete or other top surfacing material.

Construction of multilayered foundations of rigid concrete having a thin intermediate layer of sealing material between layers is a common form of construction which is used in building construction as well as in highway and airfield construction work. Such construction is used also in warehouse, factory, supermarket and swimming pool applications because it permits the laying down rapidly of a waterproofed pavement or floor supporting surface on a firm foundation.

In the usual type of concrete underlay construction, expansion joints are laid out between slabs, usually by inserting asphalted felt or other spacers. These joints are potential sources of leakage of ground water in below grade construction. Also, when batches of concrete are poured in successive pours, cracks or crevices may form at abutting pouring joints as the concrete hardens. As the foundation settles and cures, and in old concrete foundations which are to be resurfaced, "moving" cracks may develop or be present, due to shifting of the underburden and to load stresses. These cracks, too, are potential sources of water leakage. Unless the opening, whether in the form of joints, cracks, or crevices, is sealed permanently with a sealing compound or membrane, water seepage through the opening in time will lift overlaid concrete or other surfacing material laid over the first layer of concrete.

Sealing membranes in the past have consisted of moisture impervious paper, e.g. tar paper, sealed with asphalt or other similar sealing composition. The membrane is laid over the entire floor surface and carried up along the walls to form a water barrier. Seams are sealed with asphalt or other sealing material. Openings, such as joints or cracks and crevices are filled with the asphalt or the like. A modern method of water-proofing a foundation, and of sealing the so-called "moving" joints or cracks or other crevices in a masonry foundation structure, is to apply an elastomeric sealant material which adheres to the upper surface of the masonry, partially filling the openings and forming an adhered membrane over the surface of the foundation. The sealant material cures over the openings and provides a tight waterproof seal. However, when the masonry structure expands and contracts due to temperature changes, or shifts due to settling or to load stresses, the membrane, particularly the parts of the membrane extending over the openings, stretch and often rupture. Water leakage then occurs through the opening and the broken membrane, causing water damage.

In a more recent waterproofing and sealing method based on the above described method, the openings, particularly the expansion joints, are covered with plastic tape and the elastomeric sealant material is applied over the surface of the foundation, including the tapes. The elastomeric material is fast-curing and may be applied by brush or squeegee. However, it is desirable to apply it by means of a spray-gun operating under 25 to 250 psig of air pressure. When the latter method is used, the force of the spray tends to lift the tape and displace it from the joints and other crevices. Also, the elastomeric composition, as it cures, has been found to cause the tape to curl and lift away from the concrete surface to which it was adhered. The sealing membrane that is formed is then subject to rupturing particularly at large expansion joints as formerly, and, in addition, may be non-adhered when the tape has curled away from the

foundation, permitting water seepage to migrate to a broken portion of the membrane.

Similar problems of waterproofing and sealing occur in construction of roof decks and swimming pools, where the water pressure is from above, and similar methods of leak prevention have been used.

The present invention is directed to overcoming rupturing of a seamless elastomeric sealing membrane by providing means for at least parts of the membrane positioned over openings to expand, contract and otherwise move without rupturing, while the remainder of the membrane remains firmly adhered and continues to maintain a waterproof seal between the underlay to which it is adhered and the overlay laid over it.

Thus, in accordance with the present invention there is provided a method for waterproofing between layers of concrete in multilayered structures of building material of which at least the underlayer is set concrete by means of an elastomeric seamless membrane formed by depositing a layer of uncured, fast-curing, adhesive, elastomer-forming sealant composition on the upper surface of the underlayer and curing the composition before laying down the over layer on the membrane so formed, comprising coating the surface areas around openings in the upper surface of the underlayer of concrete with a fluid bond preventer composition of a thickness sufficient to prevent the composition used to form the membrane from adhering to the substrate.

Thus in accordance with the method provided by the present invention, an elastomeric, repture-proof, seamless sealing membrane particularly adapted for use in water-proofing openings, such as crevices, cracks and joints in an underlay, e.g. a concrete foundation or pavement, which is to be overlaid with set concrete or other surfacing material, may be constructed by depositing a continuous coating of bond preventer composition on the surface of the underlay only around or adjacent to such openings and preferably extending outwardly at least about 1/2 inch from the edges of the openings; depositing a layer of uncured, fast-curing, adhesive, elastomer-forming, sealant composition over the entire surface area of the underlay, including areas coated with the bond preventer composition; building up the sealant composition layer, especially over the joints, to a thickness sufficient to

form, upon curing of the latter composition, an adhered, waterproof, seamless, elastomeric membrane having sufficient body and tensile strength to permit the membrane to expand, contract and move over the openings and the coated areas without repturing while sealing the openings against passage of fluid from the underlayer to the upper layer; permitting the composition to self cure; and applying the overlay material, e.g. concrete, such as a Portland cement-aggregate mixture.

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The membrane formed according to the invention is a seamless impervious rubbery coating which is firmly adhered to the substrate on which it is formed except at those areas which are in contact with the bond preventer composition.

The non-adhered areas of the membrane expand and contract along with the substrate to which the membrane is adhered. However, in contrast to the membrane constructed by the prior art methods, the membrane has a much greater mass and area available at each opening over which to distribute the stresses of shear and elongation.

For example, in the case of the prior art seamless membrane used in sealing an expansion joint having a width of 1/2 inch in concrete substrate, the membrane is adhered to the surface of the substrate up to the edges of the joint on each side of the joint. When the joint is pulled apart, the membrane has available for elongation the mass of membrane above the nonadhered area, i.e. a strip 1/2 inch in width. Such a membrane made from carboxyl terminated liquid polysulfide polymer and having a thickness of 60 mils (0.060 inch) was found to tear at 300-400% elongation. An identical membrane formed on concrete substrate over an identical joint which had been coated with a bond preventer composition according to the invention on the surface areas on each side of the joint to a distance of 1/2 inch outwardly from the joint was found to elongate 100 to 150% before any stress was placed on the membrane and to tear only after an elongation of over 1000%. The membrane made according to the invention, as may be readily calculated, had available for elongation a mass of membrane above a nonadhered area of least 1 and 1/2 inches in width.

The method of the invention eliminates the prior art needs for splicing of sheets, laying down and adhering of tapes, and other time and labor consuming practices required with prior art methods. The invention provides a sealing and waterproofing process which forms an elastomeric, rupture-proof, waterproofing and sealing membrane having

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greater elongation and flexibility than prior art membranes. The advantages and benefits of the membrane are obtained with substantially any type of joint, crack or crevice, regardless of its configuration and whether it is horizontal or vertical in extension.

The method has application also in construction of impervious elastomeric membranes in exterior walls of foundations, cavity walls, shower pans, kitchen and toilet facilities, swimming pools, under roof flashings, and between the two-course concrete slab construction of roof decks and parking garage decks.

The invention is further described and illustrated by the drawing and the following description of preferred embodiments.

In the drawing,

FIGURE 1 shows a prior art membrane sealing a crevice and a wall abutting joint in relation to a concrete substrate;

FIGURE 2 shows the prior art membrane ruptured by expansion of the crevice and wall joint;

FIGURE 3 shows a membrane constructed according to the invention and sealing a filled joint, a crevice and a wall abutting joint in relation to a concrete substrate;

FIGURE 4 shows the membrane of Figure 3 elongated without rupturing after expansions of the joint, crevice and wall joint;

FIGURES 5 and 6 show a membrane constructed according to the invention in a coved abutting joint application before and after expansion of the joint.

The invention is further described and illustrated by reference to the drawing. In the prior practice, as shown in Figures 1 and 2, an elastomeric membrane 1, was deposited, by spraying or brushing a curable composition of membrane forming sealant, to the concrete underlay 2, and extended up the abutting wall 3 to seal the crevice 4 and the abutting joint 5. After the membrane composition had cured, the concrete overlay 6 was laid over the membrane. Upon expansion of the crevice 4 in concrete 2, and the pulling away of the joint 5, the membrane 1 was found to form ruptures 7, 8. Ground water, not shown, could pass through the ruptures 7, 8 and cause lifting of the overlay 4 and leakage through a break 9 such as that shown in Figure 2.

The rupture-proof sealing membrane of the invention is formed by a series of steps which are now described. In order to illustrate practice of the invention with different types of openings, e.g. a filled joint, a crevice, and an abutting joint, such openings have been combined in Figures 3 and 4. Referring to Figure 3, a lubricant bond preventer composition, described below, is deposited by means of a spray-gun or brush, not shown, to form bond preventer ~~coatings~~ 12 on the upper surface of the concrete underlayer 2 on each side of the crevice 4, in the corner where the underlayer 2 abutts wall 3, and over the filled joint 10, in which is positioned a filler piece 11. Each coating 12 preferably has a thickness of at least about 10 mils. However, the coating thickness may be more or less than 10 mils. It is essential only that the thickness be sufficient to prevent the composition used to form the membrane 1 from adhering to the substrate, i.e. the surface of the concrete 2 or the wall 3. Each coating 12 is applied around the periphery of each crevice 4 to form coated areas which extend from the edges of the crevice outwardly on the surface of the substrate a distance sufficient to permit the membrane formed above the crevice to elongate without rupturing while sealing the overlayer of concrete 6 against water leakage. When the coating 12 is applied in an abutting

joint application, the coating is brushed or sprayed into the corner formed by the abutting substrate 2 and the wall 3 and extended at least about 1/2 inch along each surface from the joint. In the case of an application of coating around a filled expansion joint, as in a joint 10, a filler piece 11 of asphalted felt, elastomer, or, preferably, elastomeric foam material is inserted in the joint 10. The joint 10 is filled substantially flush with the surface of the underlayer 2. The coating 12 is deposited to extend outwardly on the surface of the underlayer 2 at least about 1/2 inch and preferably about 1 inch from the edges of the joint 10 while also covering the filler 11. In coating around cracks or crevices which are greater in width than about 1/8 inch, it is desirable to fill the opening with membrane forming sealant composition or other filling material. The coating 12 is then applied over the filler as well, at a sufficient distance around the edges of the opening.

A width and thickness of coating as discussed above will usually be sufficient to provide an adequate lubricated nonadhered area around each opening, and, correspondingly, a sufficient mass of nonadhered membrane above each opening to permit such portion of the membrane to be subjected to elongation and shear stresses without rupturing.

The lubricant bond preventer composition is applied to the openings in a substrate in the form of an emulsion or solution to all openings in a working area, preferably just prior to applying membrane forming composition to the substrate.

Previous to application of the compositions, the surface to be sealed is made dust free and oil free in the usual way. The membrane forming composition, preferably an uncured liquid polysulfide polymer containing composition, as more fully described below, is deposited uniformly over the non-coated areas of the substrate by hand means, such as troweling, brushing or squeegee, or by machine means, such as a spray gun attached to metered

mixing tanks. Over the bond preventer treated areas, the membrane forming composition is built-up to form a mass, which, viewed in cross-section, is elevated somewhat like a mound 13 with its highest elevation opposite the deposits of coating 12. The deposit of composition 12 is extended beyond the ends of the crevice 3 in a similar way, not shown. The membrane forming composition is deposited on the substrate surfaces of the wall 3 and underlay 2 a sufficient distance beyond the edges of each coating 12 to provide sufficient adhering and sealing portions of membrane 1 around and alongside of each opening. The deposit of membrane forming composition should be sufficient in thickness to form a membrane 1 having a cured thickness of at least about 80 mils at its thinnest portion, and preferably from about 80 mils to about 250 mils. The elevated portions preferably should be from about 250 mils to about 350 mils in thickness above each coating 12. The membrane forming composition, described below, cures rapidly to form an impervious membrane 1, sealing the crevice 4, and overlayer of concrete 6 and the underlayer 2 from each other and adhering itself to the uncoated surfaces of the underlayer 2 and the wall 3. However, the non-adhering portions 14, of the membrane 10 are free to slide on the upper surfaces of the deposits of coatings 12.

The deposited membrane forming composition cures rapidly in from 1 to 24 hours, depending on its formulation, to form the membrane 1. The membrane 1 then is covered with an overlayer of concrete 6.

Advantages and benefits of the invention are shown in Figure 4. Thus, in Figure 4, the concrete foundation 2 has expanded and also pulled away from the wall 3 as may result from curing and settling of the foundation. The crevice 4 has widened substantially compared to its previous width, as shown, for example, in Figure 3. The adhered portion of the membrane 1 is shown firmly adhered to the surface of the concrete 2. The non-adhered portions 14 of the membrane 1 are shown in sliding contact with the

deposits of coating 6 or pulled away therefrom. The mass of membrane 1 under the elevated portions 13 of the membrane 1 has elongated substantially while maintaining contact with the overlaid concrete 6. Crevices 15 and 16 which develop in the overlayer of concrete 6, are sealed from below by the membrane 1. Also, leakage of fluids downwardly is prevented by the membrane 1. As is shown, the membrane 1 retains its sealing contact at all times with the non-coated surface of the underlayer of concrete 2.

Figures 5 and 6 further illustrate the invention as it is practiced to provide a rupture-proof sealing membrane at a joint 5 of a concrete foundation 2 and a concrete bearing wall 3 in which the corner is filled with a coving 17. The membrane 1 is deposited and formed in the manner described above over deposits of coating 12 applied on the surfaces of the coving 17, the underlayer 2 and the wall 3, substantially as shown in Figures 6 and 7. The membrane 1 is then formed, as described above, to adhere to the underlayer 2 and the wall 3 beyond the coated areas. After the membrane 1 is cured, concrete overlayer 6 is laid over the membrane 1. Figure 6 shows how the membrane 1 stretches and accommodates itself to the vertical and horizontal movements of the foundation, i.e. underlayer 2, and bearing wall 3, by pulling away from the coating 12 while remaining adhered sealingly to the surface free of the lubricant bond preventer composition.

The lubricant bond preventer composition used to form the coatings 12 may be fluid waxy, oily or polymeric material which is non-adherent to the cured membrane 1. The composition may be applied in emulsified aqueous form or dissolved in water or organic solvent. It preferably should have stability to attack by alkalies in the concrete and groundwater and by insects, fungi, and bacteria. However, the purpose of the fluid bond preventer composition is primarily to provide a substrate penetrating non-adhering surface to prevent the membrane forming composition from adhering to the surface of the concrete underlayer 2. Therefore, in the event the coating 12 is washed away

or destroyed by chemical or other attack, non-adhered portions 14 of the membrane 1 still will remain free to slide over the coated surfaces.

A preferred fluid lubricant bond preventer composition is a 25% solids content polyethylene dispersion. Another preferred composition is an aqueous emulsion of a mixture of waxes and oils. Most preferred is an emulsion of 5 to 40% of linseed oil dispersed in water with about 2% of sodium oleate. In general, soaps made from fatty acids, e.g. oleic, stearic, etc., may be used. Also useful are dispersions of waxes and oils containing 5 to 40% of the wax or oil as the dispersed phase, e.g. floor waxes.

The membrane forming composition used to make the membrane 1 preferably is a composition containing a bitumen, preferably, coal tar, and a polysulfide liquid polymer. Such compositions are well known and are described in U. S. 2,910,922 issued November 3, 1959 to Frederick P. Horning. A typical composition comprises, by weight 10% to 40% of polysulfide liquid polymer, 25 to 60% of coal tar and 25 to 60% of filler. The polymer contains recurring disulfide linkages (-S-S-) and is a polyfunctional mercaptan.

The membrane forming composition may also be an elastomeric composition containing petroleum derived bitumen, a mixture of a polysulfide liquid polymer, and a polyepoxide possessing more than one vic-epoxy group. Such compositions also are known and are described in U. S. 3,238,165 issued March 1, 1966 to Warren C. Simpson and Harry J. Sommer. A typical composition comprises, by weight, the reaction product of (1) 36% of glycidyl polyether of a polyhydric phenol of molecular weight between 250 and 900, (2) 30% of a petroleum derived asphalt, (3) 20% of a liquid polythiopolymercaptan, and (4) a catalytic amount, e.g. about 14% of a C_{12} primary amine. Preferably, the amount of the polyepoxide makes up from 15% to 90% by weight of the mixture of polyepoxide and bituminous material, and at

least 0.8 equivalent of the polythiopolymercaptan being used per equivalent of polyepoxide with an equivalent being an -SH group per epoxide group.

Also, the membrane forming composition may be a composition containing coal tar and a mixture of thiol-terminated polysulfide liquid polymer and solid non-thiol terminated polysulfide formed as the reaction product of a polysulfide and alkaline polysulfide. Such compositions are known and are described in U.S. 3,316,194 issued April 25, 1967 to Dana C. Payne and Frank D. Gaus. A typical composition comprises, by volume, about 28% of liquid polysulfide polymer, 58% of coal tar, and 12% of solid polysulfide water dispersion (5% solids, 7% water).

The polysulfide polymers used in the compositions of this invention are organic polymeric materials which are liquid at room temperature and which contain recurring polysulfide linkages, i.e. (S_n), in the polymeric backbone wherein n is, on the average, about 1.5 to 5. For chain extension and curing purposes these polymers should contain reactive groups such as -SH, -OH, $-NH_2$, -NCO. These polymers include for example, those polysulfide polymers disclosed in U.S. 2,466,963 issued April 12, 1948 to Joseph C. Patrick, et.al.; isocyanate terminated polymers such as those disclosed in British Patent 1,083,865; "high-rank" (-SSH) terminated polymers such as those disclosed in U. S. Patent 3,331,818 issued July 18, 1967 to E. R. Bertozzi; blocked "high-rank" (-SSH) terminated polymers such as those disclosed in U. S. 3,422,077 issued January 14, 1969 to E. R. Bertozzi; and amine $(-NH_2)$ terminated polymers such as those disclosed in U. S. 2,606,173 issued August 5, 1952 to E. M. Fettes, and in U. S. Patent 3,331,816 issued July 18, 1967 to E. R. Bertozzi. These polymers have a molecular weight of about 500 to 12,000 and are liquid, i.e., pourable at room temperature (about 25°C.). Structurally, they may be represented by the formula $FR'S_x(RS_x)_mR'F$ wherein x is about

1.0 to 5.0; m is an integer of from 1 to about 100; R and R' are bivalent aliphatic radicals wherein the carbon atoms may be interrupted with oxygen atoms; and F may be an -SSH; -SH; $-NH_2$; -OH; a hemiacetal or hemiketal group of the structure $-SS-\underset{OR'''}{\overset{R''}{C}}-OH$ wherein R" may be H or a lower alkyl group and wherein R''' may be lower alkyl group; or an $(O-\underset{O}{\overset{\|}{C}}-NH-R'''')-NCO$ group wherein R'''' may be an alkylene or an arylene group.

The most preferred of such polymers, according to the present invention, are those having a molecular weight of about 500 to 7500, since polymers having these preferred molecular weights allow for the most efficient cure times.

The curing agents for the liquid polysulfide polymers which may be used in the compositions of the present invention include all those materials known to the art as liquid polysulfide polymer curing agents such as polyepoxy resins, lead peroxide, calcium peroxide, barium peroxide, tellurium dioxide, manganese dioxide, cumene hydroperoxide, zinc peroxide, p-quinonedioxime, zinc oxide, the various chromate salts such as are disclosed in U.S. 2,964,503 issued December 13, 1960 to Gordon Carpenter, et.al., the curing agents of U. S. 2,606,173 and the patents previously cited, and the curing agents and accelerating agents of U.S. 3,225,017 issued to Irvin P. Seegman, et. al. on December 21, 1965. About 2.5 to 10 parts by weight of one or more of such curing agents should be used according to the present invention, per 100 parts by weight of liquid polysulfide polymer being used in the sealant composition. These curing agents may be used singularly or in various combinations with one another.

The bituminous materials used in the compositions of this invention include the materials described in U. S. 3,238,165 above and in Abraham, "Asphalts and Allied Substances," 6th edition. They include products derived from petroleum, such as, for example, asphalts, residual fuel oils and the like; high boiling extracts of petroleum, such

as those obtained by extracting petroleum with solvents having preferential selectivity for aromatic; residual fuel oils; and coal derivatives, such as, for example, coal tars, refined coal tars and coal tar pitches.

The compositions of this invention may be used in conjunction with adhesion primers and may also contain various types of materials commonly employed in such compositions such as adhesive additives, fillers, plasticizers, pigments, cure accelerators, mineral aggregate, ground resinous materials, sand and the like.

The relative amounts of the various components of the membrane forming polymer-bituminous material composition of this invention may be varied while still obtaining the advantages and benefits of the invention. In general the uncured polymer may be present in a range of from about 10% to about 40% by weight of the final composition. The bituminous materials will generally be present in a weight ratio of at least 1:1 with respect to the polymer. A preferred ratio is 2 parts of bituminous material to 1 part uncured polymer. In general the bituminous material may be present in an amount varying from about 5% to about 80% by weight of the final composition.

The invention is useful for forming improved elastomeric rupture-proof, water-proof sealing membrane for sealing crevices in substrates made of gypsum plaster, Portland cement, magnesium aluminate cement, so-called magnesium oxychloride cement, concrete made from such cements, terrazzo, plaster of Paris, and like hydraulic cementitious materials.

The invention is especially useful for forming elastomeric rupture-proof waterproof membranes for sealing crevices in building foundations, but it will also be useful for forming waterproof seals in crevices in masonry walls, e.g. concrete block or stucco walls, which have been caused by settling and where substantial expansion and contraction of the crevice occurs. The invention also has particular application in sealing leaks in home swimming pools and the like and

serves as a seal both from ground water and from pool leakage. It is also useful in forming roof decks, highway and airfield pavements.

In general, the invention is useful for obtaining improved, elastomeric, rupture-proof, water-proof seals for crevices between building materials including concrete or other cementitious materials, and other materials, e.g. wood, brick, lath, iron, steel, aluminum, copper, zinc and other metals, plastics, glass, glazed tile, vitrified tile, ceramic tile and other heat fired surfacing materials, marble, granite and other natural stone, and the like, and between any of such materials with itself or another material listed above. In some cases it will be necessary to use a metal primer or a glass or ceramic surface primer as is known in the art. The crevices which may be sealed by the process of this invention are the conventional joints existing together two bodies having a space between the adjacent surfaces of such bodies as well as cracks. While the invention has been illustrated in uses where an overlayer is used on top of the membrane, it will be obvious to those skilled in the art that the method of the invention can be used in forming elastomeric rupture-proof water-proof membranes in applications where no overlayer is used, e.g. sealing walls above grade.

The following examples are merely illustrative of the invention described herein and are not intended as a limitation upon the scope thereof.

Example 1

A membrane forming composition is prepared by preparing two compositions, designated A and B, which when admixed in equal volumes result in a rapidly setting admixture C as follows:

	A Parts by Weight	B Parts by Weight	C Parts by Weight
Coal Tar*	110	75	185
Polysulfide polymer**		100	100
Lead Peroxide	13		13
Silica Thickener		25	25
Carbon black filler	17		17

(*) Coal tar oil fraction having a viscosity of less than 50 poises at 77°F.

(**) The polysulfide polymer has essentially the structure $HS(C_2H_4-O-CH_2-O-C_2H_4-S-S)_{23}C_2H_4-O-CH_2-O-C_2H_4SH$ with about 4% crosslinking or branching, has a molecular weight of about 4,000, and an average viscosity at 77°F. of 400 poises.

Components A and B are charged into mixing tanks of an automatic mixing and metering machine to which are attached an air compressor and spray hoses and nozzles. The components A and B are mixed in the spray of the nozzles in a known way to form a spray of composition C.

The composition C is now ready for spraying on the surface of a freshly poured and set mixture of Portland cement-aggregate concrete which forms the foundation layer of a two-layer concrete flooring. The areas around and over each joint and crevice are brushed with a coating of a 25% solids content polyethylene emulsion which serves as a lubricant bond preventer composition. The coated areas extend at least 1/2 inch to about 1 inch outwardly from the edges of each joint and crevice.. Each joint and crevice over 1/8 inch in width is filled with composition C. The concrete is then sprayed with composition C to form a deposit of about 60 mils in thickness. Areas over joints and crevices are built-up to about 150 mils. The spraying is done at a temperature above 40°F.

The composition C has a viscosity of about 165 poises. It has a working time of about 5 minutes and cures in about 45 minutes at 75°F. at a relative humidity of 50%. The cured membrane has a tensile strength of 50 psi and an elongation of 700%. Its 100% modulus is 16 psi and its shear strength is 20 psi.

An upper layer of Portland cement aggregate concrete is then poured and set over the cured membrane. The cured membrane forms a rupture-proof elastomeric, waterproof seal between the upper and lower layers of concrete.

Example 2

Simulated expansion joints were made in the laboratory using solid concrete blocks measuring 3"x5"x8". Various joints were made, using mortar joint filler, with horizontal and with vertical seams. With each type of joint, the effect of the presence or absence of lubricant bond preventer around the joint was determined. The results are shown in Table 1.

In the table, tests with an edge-to-edge joint, as carried out in tests 2-A, 2-B and 2-C, show that the membrane over joints treated with wax emulsion (2-B and 2-C) have a 100% higher extension before tearing than does the membrane over a taped joint, (2-A), thus demonstrating the advantage of the use of a bond preventer composition under the membrane over the joint. Similarly, in the table, tests with an edge-to-surface abutting joint, as carried out in tests 2-D, 2-E and 2-F, show that with neither tape nor wax emulsion over the joint, the membrane in test 2-D tore at 1/2" extension. In test 2-E, while the membrane did not tear, the tape pulled loose from the substrate. In test 2-F, where wax emulsion was present on the joint and on the abutting wall, surface at the joint, the membrane was extended more than 1/2" before tearing. The membrane did not lose its bond at the 90° joint. Thus, it is seen that the use of a bond preventer composition at the abutting joint is also advantageous.

Example 3

A membrane forming sealant formulation containing a mixture of coal tar, liquid polysulfide polymer and polyepoxide is prepared by admixing components A and B for the following composition:

	A Parts by Weight	B Parts by Weight
Coal Tar*	10	10
Polyepoxide**		100
Polysulfide***	100	
tris(dimethyl-aminomethyl phenol)	10	

(*) Heavy coal tar oil fraction having a viscosity less than 50 poises at 77°F.

(**) The polyepoxide is prepared in the manner described for Polyether E of U. S. Patent 2,633,458.

(***) The polysulfide polymer has essentially the structure $HS(C_2H_4\text{-}O\text{-}CH_2\text{-}O\text{-}C_2H_4\text{-}S\text{-}S)_{23}C_2H_4O\text{-}CH_2O\text{-}C_2H_4\text{-}SH$ with about 3% crosslinking.

The components A and B are mixed by hand and applied by trowell and squeegee to a concrete foundation and walls having their joints and cracks previously treated with an emulsion of 40% of linseed oil dispersed in water with about 2% of sodium oleate. Upon curing, the mixture forms an elastomeric rupture-proof, waterproof membrane over the covered surfaces.

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TABLE I

Tests	Underlayer Structure	Joint	Joint Treatment	Membrane Characteristics	Overlayer Structure	Membrane Test Results
2-A	Two 3"x5"x8" concrete blocks, side by side	7/8" wide, mortar filled flush.	Covered with 2" wide poly-ethylene tape.	Composition C of Example 1, 60 mils thick.	One 3"x5"x8" concrete block on cured membrane	Tore at 1/4" extension.
2-B	"	"	Coated with wax emulsion	"	"	Tore at 1/2"+ extension.
2-C	"	7/8" wide, mortar filled, caulked with 1/4"x7/8" of Composition C.	"	"	"	Tore at 1/2"+ extension.
2-D	Two 3"x5"x8" concrete blocks, butted edge to face	7/8" wide, mortar filled, flush.	None	" Membrane extends on surface of under-layer and up side wall.	"	Tore at 1/2" extension
2-E	"	"	2"wide poly-ethylene tape over joint.	"	"	At 1/2" extension membrane lifted from tape, tape curled.
2-F	"	"	Coated with wax emulsion on surface and side wall at joint.	"	"	1/2"+; no loss of bond at 90° joint

The Claims defining the invention are as follows:

1. In the method for waterproofing between layers of concrete in multilayered structures of building material of which at least the underlayer is set concrete by means of an elastomeric seamless membrane formed by depositing a layer of uncured, fast-curing, adhesive, elastomer-forming sealant composition on the upper surface of the underlayer and curing the composition before laying down the over layer on the membrane so formed, the improvment which comprises coating the surface areas around openings in the upper surface of the underlayer of concrete with a fluid bond preventer composition of a thickness sufficient to prevent the composition used to form the membrane from adhering to the substrate.

2. The method according to Claim 1 wherein the bond preventer composition is a lubricant material.

3. The method according to Claim 2 wherein the bond preventer composition is selected from an aqueous dispersion of polyethylene solids, an aqueous emulsion comprising waxes, and an emulsion of 5 to 40% by weight of linseed oil dispersed in water with about 2% by weight of sodium oleate.

4. A method for preparing an elastomeric, rupture-proof, seamless sealing membrane between over and under layers of building materials of which at least the under layer is set concrete in multilayered structures, which comprises:

coating surface areas around joints, cracks, crevices and other openings in the

upper surface of the underlayer of concrete to be covered and sealed by the membrane with a continuous deposit of a fluid bond preventer composition in a sufficient amount to prevent the composition used to form the membrane from adhering to the substrate depositing a layer of uncured, fast-curing, adhesive, elastomer forming sealant composition at least over that portion of the upper surface area of the underlayer of concrete to be waterproofed, including areas coated with the bond preventer composition, in a membrane forming amount,

building up the sealant composition over the openings and coated areas to a thickness sufficient to form, upon curing of the sealant composition, an adhered, waterproof, seamless elastomeric membrane having sufficient body and tensile strength to permit the membrane to expand, contract and move over the openings and the coated areas without rupturing while sealing the openings against passage of fluid from the underlayer to the upper layer, permitting the sealant composition to self cure, and

applying the overlayer building material over the cured membrane.

The method of Claim 4 wherein the bond preventer

composition extends outwardly from the edges of said joints cracks crevices and other openings for a distance of at least about 1/2 inch.

6. The method of Claim 4 wherein the bond preventer composition is a lubricant material.

7. The method of Claim 4 wherein the sealant composition comprises a bituminous material and a liquid polysulfide polymer.

8. The method of Claim 7 wherein the sealant composition comprises polyepoxide possessing more than one vic-epoxy group.

9. The method of Claim 7 wherein the sealant composition comprises solid polysulfide.

10. The method of Claim 7 wherein the bituminous material is a coal tar oil.

11. The method of Claim 4 wherein the overlayer of building material is set concrete.

12. A multilayered structure including a sealing membrane made according to the method of Claim 4.

13. A multilayered structure including a sealing membrane made according to the method of Claim 5.

14. A multilayered structure including a sealing membrane made according to the method of Claim 6.

15. A multilayered structure including a sealing membrane made according to the method of Claim 7.

16. A multilayered structure including a sealing membrane made according to the method of Claim 8.

17. A multilayered structure including a sealing membrane made according to the method of Claim 9.

18. A multilayered structure including a sealing

membrane made according to the method of Claim 10.

19. A multilayered structure including a sealing membrane made according to the method of Claim 11.

20. A method according to Claim 1 substantially as hereinbefore described with reference to the Examples.

DATED: 9th May, 1974.

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Attorneys for:-
THIOKOL CHEMICAL CORPORATION

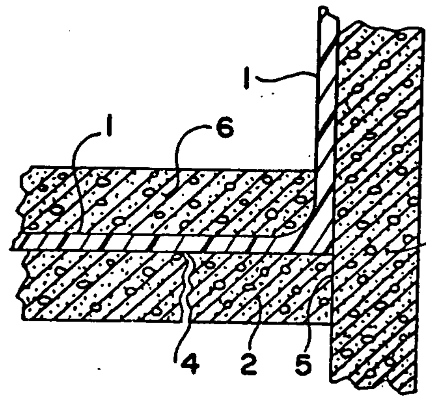

Fig.1

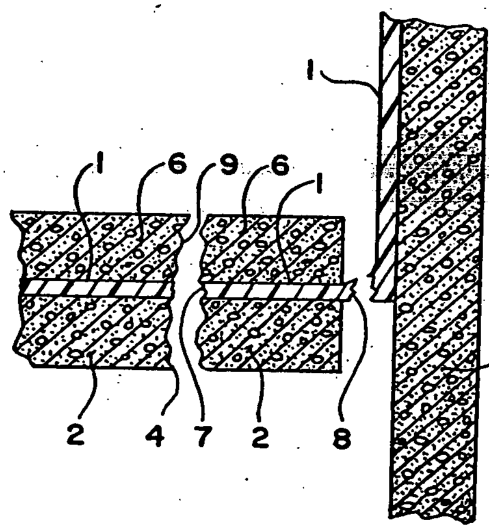

Fig.2

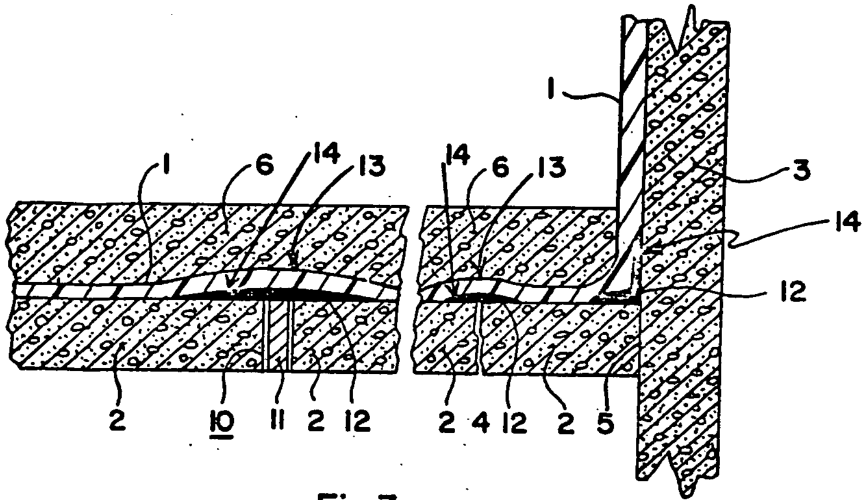
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Fig.3

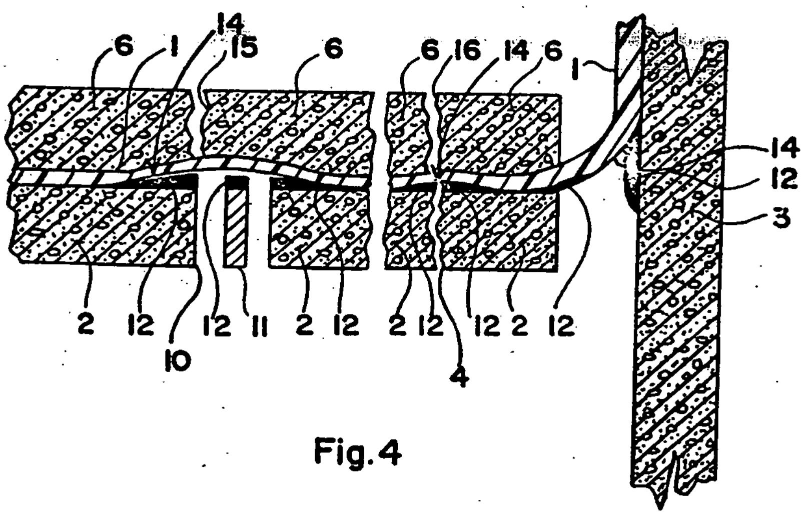
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Fig.4